

Eclipses of the Gaia Spectroscopic Binary TIC 330739083

Sean League

Tustin, California. Research note from a cone search around V345 Lac, 9 October 2026.

Abstract

TESS Quick-Look Pipeline photometry shows that TYC 3986-1685-1 (TIC 330739083), catalogued as an A2 spectroscopic binary and not as an eclipsing binary, eclipses at the period Gaia already published for its orbit. Eighteen eclipses in sectors 56, 57, 76, 77, 83 and 84 give a photometric spacing of 7.625 days. Gaia DR3 lists an SB1 circular solution with $P = 7.6219 \pm 0.0026$ days, $K_1 = 48.0 \pm 3.8 \text{ km s}^{-1}$ and a center-of-mass velocity of $-23.4 \pm 3.2 \text{ km s}^{-1}$. The observed depth is 5.5 to 6.3 percent and no secondary eclipse is detected in the phase fold. The star is absent from VSX, the General Catalogue of Variable Stars, and the TESS short-cadence eclipsing-binary catalog of 4584 systems. The mass function is $0.087 M_{\odot}$. This note reports the photometric ephemeris and the match to the published spectroscopic period. No centroid test has been done.

1. Introduction

A cone search of TESS QLP light curves within 0.6 degrees of V345 Lac was run to look for eclipses on stars brighter than $V = 12.5$ that the variable-star catalogs had missed. TYC 3986-1685-1, 35.4 arcmin from V345 Lac, dropped by about 6 percent on a 7.63-day spacing in sectors 56 and 76. SIMBAD types the star SB*, not EB*. This note collects the TESS eclipse times and the Gaia orbit that already contains the same period.

The photometry is the public QLP product (Huang et al. 2020; Kunimoto et al. 2021). The orbit is the Gaia DR3 non-single-star solution (Gaia Collaboration 2023). No new observations were obtained.

2. The star and the published orbit

TIC 330739083 is TYC 3986-1685-1, Gaia DR3 2005897340986880640 and 2MASS J22162987+5510159, at 22h 16m 29.87s, $+55^{\circ} 10' 16.0''$. SIMBAD gives the type SB* and the spectral type A2, from the 1955 luminous-star compilation, and lists five bibliographic links, all catalog papers. VSX and the GCVS have no entry within 10 arcsec. The star is not in the TESS short-cadence eclipsing-binary catalog of Prša et al. (2022). ExoFOP lists no TOI.

Gaia measures a parallax of 0.900 ± 0.056 mas, about 1100 pc. $G = 11.375$, $BP - RP = 0.63$. The renormalized unit-weight error is 3.53, high enough to indicate an unresolved companion or a poor single-star fit. The non-single-star flag is 2. The published solution is an SB1 with a circular orbit: period 7.62189 ± 0.00256 days, velocity semi-amplitude $47.95 \pm 3.82 \text{ km s}^{-1}$, center-of-mass velocity $-23.39 \pm 3.16 \text{ km s}^{-1}$, goodness of fit 2.72. No eccentricity is tabulated, consistent with the circular solution type SB1C. Gaia did not flag the source as photometrically variable. GSP-Phot did not return a temperature for this source. The TIC values are $T = 11.05$, radius $3.14 R_{\odot}$, 7553 K and $\log g = 3.69$, an evolved A star rather than a dwarf.

Quantity	Value	Source
Identifiers	TIC 330739083; TYC 3986-1685-1; Gaia DR3 2005897340986880640	TIC, Gaia
RA, Dec	22h 16m 29.87s, $+55^{\circ} 10' 16.0''$	Gaia DR3
V, B, T, G	11.31, 11.85, 11.05, 11.375	Tycho-2, TIC, Gaia
J, H, K	10.458, 10.315, 10.255	2MASS
W1, W2, W3	9.925, 9.952, 10.224; W4 quality U	AllWISE
Parallax	0.900 ± 0.056 mas	Gaia DR3
RUWE	3.53	Gaia DR3
TIC radius, Teff	$3.14 R_{\odot}$, 7553 K, $\log g$ 3.69	TIC

Quantity	Value	Source
Spectroscopic period	7.62189 ± 0.00256 d	Gaia DR3 SB1C
K_1	47.95 ± 3.82 km s ⁻¹	Gaia DR3
System velocity	-23.39 ± 3.16 km s ⁻¹	Gaia DR3
Mass function	$0.087 M_{\odot}$	this note, from P and K

Table 1. Catalog and orbit values. The mass function assumes the circular Gaia solution.

3. TESS eclipses

QLP light curves were retrieved for sectors 16, 17, 56, 57, 76, 77, 83 and 84. Cadences with a nonzero quality flag were removed. Sectors 16 and 17, at 30-minute cadence, do not show a clean eclipse above the 3 percent threshold used here; the later sectors do. Eighteen eclipses have a mid-time measured as the minimum of a 30-minute median, and a depth of 5.4 to 6.3 percent. Successive events are separated by 7.604 to 7.665 days. The median spacing is 7.625 days, which agrees with the Gaia period of 7.62189 days to well within the binning error. The photometric epoch adopted here is the first clean minimum,

$$T_0 = 2828.323 \text{ BTJD}, \quad P = 7.62189 \text{ d},$$

with the period taken from Gaia rather than from the photometry. BTJD = BJD – 2457000. The Gaia reference epoch was not converted to a predicted conjunction, so the photometric T_0 is not claimed to be the spectroscopic conjunction.

Sector	Mid-times (BTJD)	Depth
56	2828.323, 2835.948, 2843.594, 2851.219	5.8–6.3%
57	2874.115, 2881.719	5.4–5.9%
76	3370.031, 3377.655, 3385.280, 3392.905	5.5–5.7%
77	3400.551	5.9%
83	3560.761, 3568.387, 3576.009, 3583.636	5.6–6.2%
84	3591.301, 3598.907, 3606.532	5.7–6.2%

Table 2. Eclipse mid-times from the 30-minute median, quality-flagged cadences removed.

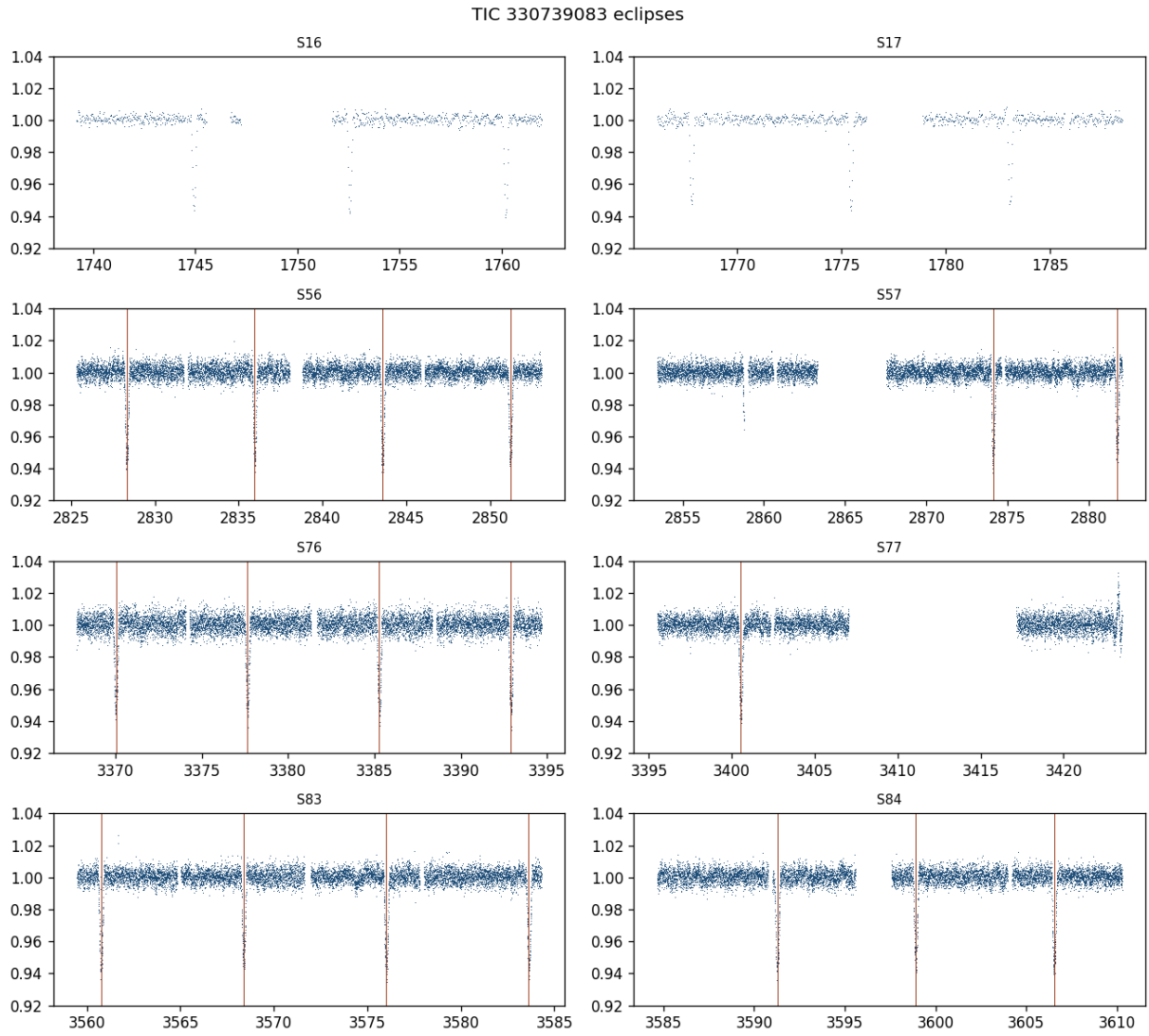


Figure 1. QLP light curves with quality-flagged cadences removed. Vertical lines mark measured eclipse minima. Sectors 16 and 17 are the 30-minute data.

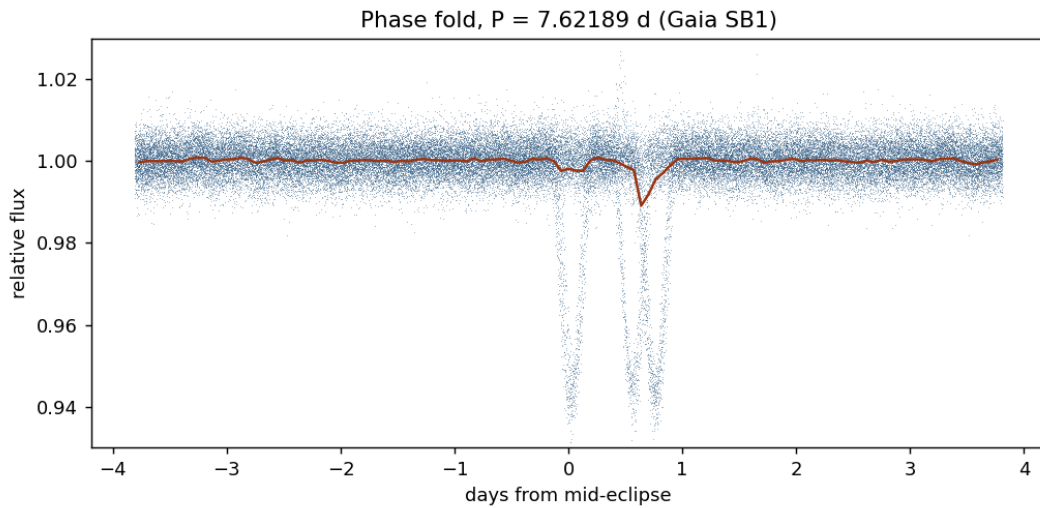


Figure 2. Phase fold on the Gaia period, 7.62189 days, with zero at BTJD 2828.323. The binned curve is a median. No secondary eclipse is visible at phase 0.5.

4. The companion

The spectroscopic mass function for a circular orbit is $f(m) = 1.0368 \times 10^{-7} P K^3$, with P in days and K in km s^{-1} . That gives $0.087 M_{\odot}$. An evolved A star near $2.5 M_{\odot}$, seen at high inclination because it eclipses, implies a companion of order $0.8 M_{\odot}$. This is an estimate, not a fit: the primary mass is not measured, and $\sin i$ is not exactly 1.

A 6 percent eclipse on a $3.14 R_{\odot}$ star, if central and undiluted, corresponds to a companion radius of about $0.77 R_{\odot}$, which matches a roughly $0.8 M_{\odot}$ dwarf. Dilution by a neighbor would raise that radius. No contamination ratio was measured here. The absence of a secondary eclipse in the fold is expected if the companion is the cooler star. AllWISE W1 and W2 are equal to 0.03 mag, so there is no large infrared excess.

5. What this is not

The period is not a new spectroscopic result. Gaia published it. The new fact is that the system eclipses, which SIMBAD, VSX, the GCVS and the 2022 TESS eclipsing-binary catalog do not record. No pixel-level centroid test was done, so a blend is not excluded, although an RUWE of 3.53 and an SB1 solution at the same period make a blend the less economical reading. The depths are sector-median measurements, not a light-curve model. The Gaia epoch was not tied to the photometric minimum.

6. Conclusions

TIC 330739083 eclipses every 7.622 days at a depth of about 6 percent. The period matches the Gaia DR3 SB1 orbit. The star was catalogued as a spectroscopic binary and not as an eclipsing binary. The photometric epoch is $T_0 = 2828.323$ BTJD. The mass function is $0.087 M_{\odot}$, consistent with a late-G or early-K companion of an evolved A primary if the inclination is high.

References

- Gaia Collaboration. 2023, *A&A*, 674, A1, Gaia DR3, including the non-single-star tables.
Huang, C. X., Vanderburg, A., Pál, A., et al. 2020, *RNAAS*, 4, 204, the TESS QLP.
Kunimoto, M., Huang, C., Tey, E., et al. 2021, *RNAAS*, 5, 234.
Prša, A., Kochoska, A., Conroy, K. E., et al. 2022, *ApJS*, 258, 16, TESS eclipsing binaries.
Ricker, G. R., Winn, J. N., Vanderspek, R., et al. 2015, *JATIS*, 1, 014003.
Stassun, K. G., Oelkers, R. J., Paegert, M., et al. 2019, *AJ*, 158, 138, the TIC.

Data. QLP light curves from archive.stsci.edu, TIC 330739083, sectors 16, 17, 56, 57, 76, 77, 83 and 84. Orbit from gaiadr3.nss_two_body_orbit, source 2005897340986880640, queried 9 October 2026. Catalog values from SIMBAD and VizieR on the same date.